DOCUMENT RESUME

ED 250 487 CE 039 969

AUTHOR Edwards, Charles W., III
TITLE Biotechnician Needs Analysis.
INSTITUTION Triton Coll., River Grove, Ill.
SPONS AGENCY Illinois State Board of Education, Springfield. Dept. of Adult, Vocational and Technical Education.
PUB DATE Jun 84
NOTE 57p.
PUB TYPE Reports - Research/Technical (143) -- Tests/Evaluation Instruments (160)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS *Biology; *Curriculum Development; DNA; Educational Research; Genetic Engineering; *Genetics; Industry; *Needs Assessment; *Paraprofessional Personnel; Postsecondary Education; State Surveys; Technical Education; Technological Advancement; *Technology
IDENTIFIERS *Biotechnology; Illinois

ABSTRACT

The need for the development of a biotechnician curriculum was investigated. A search for operational job descriptions for biotechnicians was conducted. Industry consensus was that this is a generic term too broad to be useful. Biotechnology companies within a 300-mile radius of Chicago and universities and other colleges in Illinois that hire technicians were identified and contacted to determine labor force demand for technicians in biotechnology fields. It was determined that there is not sufficient need for associate degree technicians to warrant development of a biotechnician curriculum at this time. (Attachments, amounting to over one-half of the report, include questionnaires, questionnaire results by company and university, and data summaries.) (YLB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

IL8413110

Biotechnician Needs Analysis

Illinois State Board of Education

Adult, Vocational and Technical Education

ED250487

PROJECT STAFF

Lynn Sullivan Parker, Director
Charles W. Edwards
Principal Investigator

School of Career Education

Triton College

River Grove, Illinois

Edward Copeland
Chairman

Donald G. Gill
State Superintendent
of Education

Research and Development Section

June 1984

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

This document has been reproduced as received from the person or organization originating it.

Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

D Gill

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

CE039969

An Equal Opportunity/Affirmative Action Employer

Final Report Abstract

Official Project Title: Biotechnician Needs Analysis

Department of Adult, Vocational and Technical Education Funding Agreement Number: R-31-14-X-0332-5●6

Project Director: Lynn Sullivan Parker

Funded Agency: Triton College

Location of Funded Agency: 2000 Fifth Avenue, River Grove, Illinois 60171

Time Period Covered: August 15, 1983 - June 30, 1984

Major Accomplishments of the Project:

1. A search for operational job descriptions for "biotechnicians" was conducted. At present, industry consensus is that this is a generic term and one which is too broad to be useful.
2. Biotechnology companies within a 300 mile [illegible]us of Chicago were identified and contacted to determine manpower demand for technicians in biotechnology fields.
3. Universities in Illinois which hire technicians were contacted to determine their manpower needs.
4. Other colleges with biotechnician-like programs were identified and contacted regarding their assessment of employment demand.
5. It was determined that there is not sufficient need for Associate degree technicians to warrant development of a biotechnician curriculum at this time.

Potential Impact on Vocational Education:

This report will be of assistance to Illinois agencies of higher education and to other educational institutions in the State which have contemplated initiating a similar program. In addition, future reevaluations of biotechnology manpower needs will be facilitated with the industry contacts established through this project.

Products Delivered: (Indicate titles, types, quantity, recipients and date of delivery)

Ten copies of the final report entitled "Biotechnician Needs Analysis" were delivered to the Research and Development Contract Administrator June 30, 1984.

PAID PARTICIPANTS IN ACTIVITY

Director: Lynn Sullivan Parker
Associate Dean, Human Resource Development
(formerly Associate Dean, School of Career Education)
Triton College
2000 Fifth Avenue
River Grove, Illinois 60171

Dean Parker's community college administrative experience has provided her with relevant knowledge about curricula and the curriculum development process.

Principal Investigator: Charles W. Edwards
Project Consultant

Charles W. Edwards III
21W551 North Avenue #228
Lombard, Illinois, 60148

Graduate Student, Department of Microbiology, Loyola University Medical Center

1977	B.A. Biochemistry and Molecular Biology, Northwestern University, Evanston, Illinois
1978	B.S. Microbiology and Public Health, Michigan State University, East Lansing, Michigan
1978-1981	Laboratory Technician, Difco Laboratories, Detroit, Michigan. Duties: preparation, packaging, and testing of TC Chromosome kits, tissue culture media, fluorescent antibodies
1981-present	Graduate student, Department of Microbiology, Loyola University Medical Center, Maywood, Illinois. Research: Molecular and genetic analysis of recombination deficient mutants of the yeast Saccharomyces cerevisiae
Sept. 1982	Attended XIV International Conference on Yeast Genetics and Molecular Biology, Montpelier, France.
Aug. 1983	Attended and presented poster, Cold Spring Harbor Symposium on Yeast Genetics and Molecular Biology, Cold Spring Harbor, New York

RESOURCE LISTING

1. Material Resources:

No material resources were purchased for express use by this project.

2. Human Resources

The following people provided assistance in retrieval of pertinent reference material:

Florence Weese
Librarian
Triton College

Lois Pye
Career Planning and Placement Specialist
Triton College

The following people provided assistance with this study by providing information concerning the field of biotechnology with respect to industry and academia:

Lois Pye
Career Planning and Placement Specialist
Triton College

Susan M. Kuncio
Director of Career Planning and Placement
Cayuga County Community College
Franklin Street
Auburn, New York 13021

Dr. Gunstream
Pasadena City College
Pasadena, California

Raymond L. Teplitz, M.D.
City of Hope National Medical Center
1500 East Duarte Road
Duarte, Caolifornia 91010

E.H. Dunlop, Ph.D., Professor
Chemical Engineering and Biotechnology
Center for Biotechnology
Washington University in St. Louis
St. Louis, Missouri 63130

Carol C. Epstein, Ph.D.
Midwest and Ph.D. Recruiting Manager
Dow Chemical U.S.A.
1801 Building
Midland, Michigan 48640

Susanne Hersh
Personnel Manager
Applied Molecular Genetics (AMGen)
1900 Oak Terrace Lane
Thousand Oaks, California 91320

Robert Weist
Vice President and Genral Counsel
AMGen
1900 Oak Terrace Lane
Thousand Oaks, California 91320

Susan Hart-Wadley
Corporate Recruiter
Abbott Laboratories
Abbott Park
Abbott, Illinois 60064

Thomas J. Skatrud, Ph.D.
Research Director
Bio-Technical Resources
7th & Marshall Streets
Manitowoc, Wisconsin 54220

John W. Crooks
Manager, College Relations
Eli Lilly & Co.
307 E. McCarty Street
Indianapolis, Indiana 46285

Robert S. Rhine
Business Manager
GCA/Precision Scientific Group
3737 Cortland Street
Chicago, Illinois 60647

Michael E. Jolley, Ph.D.
Vice President of Reasearch and Development
Pandex Laboratories, Inc.
909 Orchard Street
Mundelein, Illinois 60060

Joyce Coleman
Corporate Manger
Life Technologies, Inc.
P.O. Box 200
Chagrin Falls, Ohio 44022

J. John Marshall, Ph.D.
President
Consolidated Biotechnology, Inc.
1413 West Indiana Avenue
P.O. Box 2086
Elkhart, Indiana 46515

Clyde R. Goodheart, Ph.D.
President
Biolabs, Inc.
2810 MacArthur Blvd.
Northbrook, Illinois 60062

Mike Umphres
Travenol Labs, Inc.
Route 102 & Wilson Road
Round Lake, Illinois 60073

Mildred J. Clark
Administrative Coordinator
Kraft Inc.
Kraft Court
Glenview, Illinois 60025

Dale Fox, Ph.D.
Monsanto Co.
800 North Lindbergh Blvd.
St. Louis, Missouri 63167

Lance D. Williams
Employment Representative
The Upjohn Company
7000 Portage Road
Kalamazoo, Michigan 49001

Lowell P. Hager, Ph.D.
Chairman
Department of Biochemistry
University of Illinois at Urbana-Champaign
Urbana, Illinois 61081

Richard L. Davidson, Ph.D.
Professor and Director
Center for Genetics
University of Illinois College of Medicine
808 South Wood Street
Chicago, Illinois 60612

Benton H. Stidl, Ph.D.
Chairperson
Department of Biological Sciences
College of Arts and Sciences
Western Illinois University
Macomb, Illinois 61455

Robert M. Roth, Ph.D.
Chairman
Department of Biology
Lewis College of Sciences and Letters
Illinois Institute of Technology
Chicago, Illinois 60616

Francis C. Neuhaus, Ph.D.
Professor and Chairman
Department of Biochemistry, Molecular
Biology, and Cell Biology
Northwestern University
2153 Sheridan Road
Evanston, Illinois 60201

Robert E. Malone, Ph.D.
Associate Professor
Department of Microbiology
Loyola University Medical Center
2160 S. First Avenue
Maywood, Illinois 60153

Herbert L. Mathews, Ph.D.
Associate Professor
Department of Microbiology
Loyola Univeristy Medical Center
2160 S. First Avenue
Maywood, Illinois 60153

Tom Frederick, Ph.D.
Department Chairman
Department of Biology
Rochester Institute of Technology
One Lomb Memorial Drive
Rochester, New York 14623

MAJOR ACCOMPLISHMENTS AND SIGNIFICANT FINDINGS

1. Project Goals and Activities

PROJECT OBJECTIVE: To investigate the need for the development of a biotechnician curriculum and to develop a curriculum using the DACUM process if a need is indicated.

A. What is Biotechnology?

Mayor Jane Byrne's Task Force on High Technology Development defined biotechnology "as the use of biological processes in commercially relevant activities." The November/December issue of "Genetic Engineering News" (GEN) breaks down the field of biotechnology into nine technologies: 1) recombinant DNA, 2) fermentation, 3) purification, 4) hybridoma/cell fusion, 5) cell/tissue culture, 6) enzymology, 7) separations, 8) sequencing, and 9) synthesis. A brief description of each of the nine biotechnology technologies follows.

Recombinant DNA technics allow scientists to precisely cut and restructure the long ribbony blueprints of life called DNA (deoxyribonucleic acid). The cutting and restructuring of DNA is used to isolate biologically important segments of DNA, called genes, which determine the structure of proteins, which in turn can be mass produced very quickly be microorganisms. Important proteins mass-produced in this way include insulin, human growth hormone, interferon, and interleukin-2, and more are on the way. The mass production of these normally scarce proteins is much cheaper than extracting them from tissues or fluids. The proteins produced are identical to those normally occurring in the body.

Fermentation technics have been known to man since the dawn of history. Fermentation can be defined as the utilization of microorganisms to break down common and plentiful compounds into scarce useful products. Yeast breaks down sugar into alcohol, bacteria and molds break down milk components into the smaller molecules which give certain cheeses their characteristic flavors, and even certain chemicals like acetone can be produced by bacteria. Industry is constantly trying to breed or engineer microorganisms to produce more and different compounds. Again, fermentation products are less expensive than those same products produced chemically.

Purification technics are just that. A cell is full of thousands of different compounds, each with different properties. Using a compound's unique properties, it can be selectively purified from the myriad other cell components. Recombinant DNA technics would be fruitless without purification technics. After restructuring DNA to produce a certain protein, there must be a method to purify the protein after it has been produced. There are many purification technics now which are quick and very clean, with even more being developed.

Hybridomas are hybrid cells made with cell fusion technics. In all higher animals, certain white blood cells produce proteins called antibodies. Antibodies serve as a defense against disease, due to their ability to recognize and attach to foreign substances such as bacteria, viruses, cancer cells, or even a blood donor's blood cells. By fusing a white blood cell which produces a desired specific type of antibody, with a cancerous white blood cell (called a myeloma), a hybridoma is produced. The hybridoma cell produces the desired specific type of antibody as the white blood cell did, while retaining the immortality of the myeloma cell. The hybridoma propagates, producing identical clones of itself with every clone producing the same antibody. These antibodies are called monoclonal antibodies.

Monoclonal antibodies can be used in diagnostic tests to quickly and cheaply detect diseases. Researchers are also hopeful that monoclonal antibodies can be made to recognize and attach to cancer cells and tumors. By attaching a very low dose of radiation to the cancer specific antibodies, scientists hope to kill cancer cells specifically, without the unpleasant side effects of conventional radiation therapy.

Cell fusion technics have other applications than producing hybridomas. Different cells with different properties can be fused together and the resulting hybrids can be selected for the desired properties of each original cell. Faster growing, disease-resistant food crops could be developed in this way. Many more applications for hybridomas and cell fusion technics are rapidly being developed.

Cell culture and tissue culture are terms often used interchangably. Cells from body tissues are detached from each other by breaking the protein bonds holding them to each other. The bonds are broken using other proteins (enzymes) capable of cutting proteins. Once the tissue has been disaggregated into individual cells, the cells are placed in culture dishes and nourished by highly defined growth media. The cells will grow to cover the culture dish with a layer of cells one cell thick, called a monolayer. Monolayers can be used to grow viruses for research or they can be used to study the cells themselves. Cell culture technics are also used to grow individual plant cells, that have been genetically altered for a certain trait, into complete healthy plants. These plants can reproduce and pass on the newly acquired trait to its progeny. Cell fusion and cell culture technics may someday be used to produce the long sought after pomatoe - a plant with potatoes for roots and tomatoes on the shoots.

Enzymology is the study, utilization, and production of proteins which carry out most of the work in every cell of every living thing. All enzymes are proteins but not all proteins are enzymens. Enzymes speed up or catalyze specific chemical reactions within the cell. Each enzyme has a different reaction to catalyze. Industrially, enzymes can be used to coagulate milk protein to make cheese, or to turn barley into malt to produce beer, or to break down wood fibers to make paper. In the home, a common enyzme is papain, which is found in meat tenderizers.

Enzymes are much more efficient and specific than chemical catalysts and can be cheaper to use. Chemical reactions catalyzed by enzymes produce more end product, faster, and under much milder and less expensive conditions, from less starting material, than their chemical counterparts. For these reasons the study and production of useful enzymes is big business and very likely to expand greatly in the future.

Separations fall into two different categories. An example of the first catagory is the use of specific technics which can separate individual proteins from one another on the basis of the protein's size and electric charge. This type of separation is often part of purification technics mentioned above.

The second type of separation is the utilization of specific microorganisms capable of selectively concentrating one specific compound from a mixture of many compounds. The microorganisms take in the desired (or unwanted) compound and the bugs can then be removed from the mixture. There are many applications for these types of separation, technics including separating oil from shale and using algae to separate hydrogen from water via photosynthesis, and using the hydrogen to make methane or natural gas.

Sequencing technics are used to break down large macromolecules, such as proteins and DNA, into their basic building blocks, and deducing the exact order the blocks were in originally. Knowledge gained from sequencing proteins and DNA yields information on how they work within the cell, as well as possible ways to improve their performance.

Synthesis technics use knowledge gained from other fields to create new compounds which are more efficient, cheaper, convenient, or any combination of the three. For example, knowledge gained through enzymology can be used to make synthetic enzymes, which can do the job better than natural enzymes. Knowledge gained from sequencing DNA and from recombinant DNA research has allowed for the production of short DNA sequences which can be used to make recombinant DNA technics more conveneint. There is no telling what synthesis technics may ultimately achieve, given time and knowledge.

It should be obvious, from this brief introduction into the world of biotechnology, that the field encompasses many technologies. It is also a fluid and developing industry. As new sciences and technics are developed and included in this broad definition of biotechnology, subdivisions will emerge.

B. Locating Information Sources

In order to investigate the need for the development of a biotechnician curriculum, employment prospects for biotechnicians with an Associate's degree had to be determined. Activities undertaken to accomplish the project objective included identifying and contacting 1) area companies likely to hire "biotechnicians", 2) selected Illinois university research laboratories, 3) selected technologically focused employment agencies, and 4) colleges or universities in the U.S. which presently offer biotechnician programs.

B 1. Biotechnology Companies

Using the November/December issue of "Genetic Engineering News" containing the GEN Guide to Biotechnology Companies, twenty-seven biotechnology companies were identified within an approximate three hundred mile radius of Chicago. Four other biotechnology firms were identified from personal experience. The thirty-one companies identified were:

Abbott Laboratories*
Agrigenetics Corporation*
AMGen*
Biolabs, Inc.*
Bio-Technical Resources*
Cetus-Madison Corporation*
Compugene
Kraft, Inc.*
Life Technologies Inc.*
Eli Lilly and Company*
Lab Systems Inc.
Miles Laboratories
Molecular Genetics Inc.
Monsanto Company*

Consolidated Biotechnology, Inc.*
D.E.P. Systems Inc.*
Dairyland Food Laboratories
Difco Laboratories*
Dow Chemical Company*
Endotronics
Fertility and Genetics Research, Inc.
Fotodyne Inc.
GCA/Precision Scientific Group*
Pandex Laboratories, Inc.*
Petrogen, Inc.
Pharmacia P-L Biochemicals
Promega Biotec
Systec, Inc.
Travenol Labs*
Universal Foods Corporation
The Upjohn Company*

The final target list of eighteen companies (those indicated by an asterisk above) was attained in the following manner. First, if a company's technologies were obviously too technical, they were eliminated. This eliminated Fertility and Genetics Research, Inc.

Second, if the technologies of a company merely supported the production of electronic systems or computer software and they were outside the State of Illinois they, too, were eliminated. This eliminated Compugene, Endotronics, Fotodyne, and Systec, Inc.

Third, Kraft Inc. was taken as a model for the food processing sector of biotechnology and other food processing companies were eliminated. This is justified since food processing companies have very few biotechnical openings and Kraft, besides being in Illinois and one of the largest food processing concerns in the Country, is a good representative of the industry. This eliminated Dairyland Food Laboratories and Universal Foods Corporation.

Finally, telephone calls were made to the remaining twenty-four companies. If they agreed to cooperate in the survey, a questionnaire was sent to them for completion. This resulted in the mailing of eighteen questionnaires to the following companies:

Abbott Laboratories
Agrigenetics Corporation
AMGen
Biolabs, Inc.
Bio-Technical Resources
Cetus-Madison Corporation
Consolidated Biotechnology, Inc.
D.E.P. Systems Inc.
Difco Laboratories
Dow Chemical Company
GCA/Precision Scientific Group
Kraft, Inc.
Life Technologies Inc.
Eli Lilly and Company
Monsanto Company
Pandex Laboratories, Inc.
Travenol Labs
The Upjohn Company

A sample of the questionnaire sent to these companies can be found in the attachments at the end of this report. Twelve of the eighteen questionnaires were returned. Two more companies provided information over the phone. The four companies that did not return the questionnaires cited confidentiality as the reason.

The questionnaire was designed to gather information regarding the present state of the company and their future needs. The sample curriculum was included in the questionnaire to show the companies what could be accomplished in a two year program. Questions regarding salary and advancement were necessary to evaluate any openings for Associate degreed people. The returned questionnaires were evaluated and a report was written for each questionnaire as they came in. The actual reports can be found in the attachments section at the end of this report. The company profiles at the end of each report were compiled using the GEN Guide to Biotechnology Companies and Dun and Bradstreet's Million Dollar Directory.

B 2. University Research Laboratories

Twenty university departments within the State of Illinois were identified and broken down into five groups. The distribution of the departments into groups was based on available information found in Peterson's Guide to Graduate Programs. At least one department head from each of the five groups was contacted and interviewed by phone, with the exception of the group headed by Loyola University Medical Center, Department of Microbiology. Information from this department was gathered through personal knowledge of the department. The five groups of departments are as follows:

Group I : Biological Sciences

Western Illinois University
Department of Biological Sciences*
Eastern Illinois University
Division of Life Science
Southern Illinois University at Carbondale
Department of Biological Sciences
Southern Illinois University at Edwardsville
Department of Biology
Loyola University of Chicago, Lake Shore
Department of Biology
Illinois Institute of Technology*
Department of Biology
DePaul University
Department of Biological Sciences
Northern Illinois University
Department of Biological Sciences

Group II : Microbiology

Loyola University Medical Center*
Department of Microbiology
Southern Illinois University at Carbondale
Department of Microbiology
University of Illinois at Urbana-Champaign
Department of Microbiology
Illinois State University
Department of Biological Sciences
University of Illinois at Chicago
Department of Biological Sciences
Northwestern University Medical School
Department of Microbiology and Immunology

Group III: Molecular Biology

Northwestern University*
Department of Biochemistry, Molecular Biology, and Cell Biology
University of Chicago
Department of Biology
Northwestern University Medical School
Department of Molecular Biology

* Denotes those universities contacted.

Group IV

University of Illinois at Urbana-Champaign*
Department of Biochemistry
Loyola University Medical Center
Department of Biochemistry
University of Chicago
Department of Biochemistry

Group V

University of Illinois College of Medicine
Center for Genetics
University of Chicago
Committee on Genetics

Group I is rather large and because of that, two departments were contacted. Western Illinois University and Illinois Institute of Technology represent opposite ends of the research spectrum of this group and they were contacted for this reason. Their responses reflect the potential least and most number of technician positions available. They will give an estimate on the whole group's employment possibilities.

Group II contains departments dealing with microbiology. Loyola University Medical School is a good representative of the groups based on the types of research the department is undertaking.

Group III is comprised of three departments working in molecular biology. Any of the departments could have served as the representative department but Northwestern University was chosen.

Group IV deals with biochemistry departments. The department at the University of Illinois at Urbana-Champaign was chosen because of its location in the State.

Group V contains just two genetics programs. The University of Illinois College of Medicine was contacted because contact with the University of Chicago was unavailable.

B 3. Technologically-Focused Employment Agencies

Concurrently with the above activities, a search for an industry-accepted biotechnician job description was underway. The search was conducted to locate current biotechnicain job openings, if any, as well as to obtain examples of biotechnician job descriptions. To accomplish this, employment agencies specializing in bio-technical and allied fields were identified using Triton College's Center for Career Planning and Placement. The agencies identified and contacted are:

Afirm
Altech
Chemical Personnel Search
Technology Associates Inc.
Pro Chem Inc.
C.P.S.

B 4. Colleges and Universities with Biotechnology Programs

Finally, colleges and universities were identified which have biotechnology or related programs, or were investigating the need for initiating such programs. Six of these institutions were contacted and their programs or activities were discussed. These institutions are:

Pasadena City College
Cayuga County Community College
Illinois Institute of Technology
Washington University at St. Louis
Rochester Institute of Technology
Middlesex County College

C. Research Findings

Biotechnology is an emerging field which encompasses many sciences such as biochemistry, molecular biology, genetics and microbiology. Microbiology itself, can be broken down into various disciplines, such as bacteriology, virology, immunology, mycology, and parisitology. With all of these disciplines and many others covered by the single term "biotechnology," the job title "biotechnician" becomes hard to define.

The vagueness of the job title biotechnician was reinforced through correspondence with various sources. Technical employment services contacted had not heard of any job listings for biotechnicians per se. They have had listings entitled "microbiologist", "biochemist", or "molecular biologist" which do indeed fall into the biotechnology category, but they are much more descriptive terms. A bona fide biotechnician would need to be versed in all disciplines of biotechnology. Dr. Robert Roth, head of the Illinois Institute of Technology's Department of Biological Sciences, doubts even a four-year program would be enough to qualify someone as a biotechnician.

The vastness of the field makes it very hard to design a curriculum for a two-year program in biotechnology. In order to begin instructing students in the various fields of biotechnology many prerequisite courses must be completed. Students must have passed college level courses in calculus, inorganic chemistry, organic chemistry, analytical chemistry, physical chemistry, physics, and basic biology before they can even attempt biochemistry or microbiology. It would take nearly two years of study just to fulfill the necessary prerequisites.

Completion of the prerequisite courses alone may be of some value to employers. Dr. Clyde Goodheart, president of Biolabs, Inc. feels that a strong background in chemistry would allow technicians to prepare solutions and media, an essential task in any biotechnical laboratory. Similar positions are available in university research labs, but they are limited, since those universities having such positions would only require one or two technicians of this type.

The inclusion of courses in microbiology and biochemistry in a two-year program would make its graduates more marketable. The University of Illinois is experiencing a shortage of technicians. It seems that their graduates usually leave the Urbana-Champaign area soon after graduation. Even limited knowledge in microbiology and biochemistry would enable technicians to work in academic departments. However, the number of positions open would be small, and the turnover rate is low, resulting in a low demand for technicians of only one, or at most,

two openings a year.[1] Universities in the Chicago area have a consistently large number of new graduates to draw upon for technical positions. They would prefer to hire someone with a four-year degree than a two-year degree, because the broader background of a four-year graduate affords greater flexibility to the technician.

The general feeling of universities is that a two-year degree would be adequate for positions involving media and reagent preparation, and labware sterilization. The exception, as mentioned above, is the University of Illinois, Champaign-Urbana. However, the U. of I. has the facilities, faculty, and staff to train their own technicians.

Biotechnology companies vary dramatically in their attitudes toward hiring someone with an Associate's degree. Company responses to the questionnaire are summarized in a chart located on pages A21 and A22 of this report. Five of the fourteen responding companies expressed interest in hiring Associate degreed technicians. AMGen said they had sixteen openings right now and Monsanto has eight openings presently. AMGen is presently located in California; they will be opening a pilot plant facility in Chicago's High Tech Park within the year. Monsanto is located in St. Louis. Dow Chemical Company in Midland, Michigan also says they will have one or two openings a year for the next five years for Associate degreed technicians. The other two companies interested in Associate degreed technicians are in the Chicago area. Biolabs, Inc. in Northbrook may need fifteen technicians three years from now. Biolabs is a small company and its survival will depend on the success of current and future products. GCA/Precision Scientific Group is headquartered in Chicago and may need five technicians in five years and one now. It is clear there is a niche in industry for Associate degreed technicians, but this niche is currently very small and mostly out-of-state.

The largest potential enployers of technicians in the Midwest were not interested in hiring Associate degree technicians. Abbott Laboratories in North Chicago said they would be interested if the program were a four year program instead of two years. Travenol Labs in Round Lake has similar sentiments, as did Upjohn Company in Kalamazoo, Michigan and Eli Lilly in Indianapolis. Travenol does not need any technicians in the Chicago area. The other three companies, Abbott, Upjohn, and Lilly, seem to share a common problem. Their employees work on one project to completion and then are shifted to new projects. This requires workers to be flexible and to have a broad educational base, to minimize retraining time between projects. For this reason, these companies prefer people with a minimum of a bachelor's degree. Also, these companies recruit workers from all over the U.S., giving them an enormous pool of potential employees. They naturally hire the best of the available graduates who fit their current particular need.

Another consideration in deciding the feasability of initiating a two-year program in biotechnology is the state of the industry as a whole. There is no doubt the industry will grow in the future. But there will be a limit as to the number of companies and workers the industry can accommodate. Once this limit is reached, a "shaking out" will occur. Struggling firms will fold or be acquired by other, healthier firms. Workers and technicians will be laid off. These workers, because of their experience, would be hired over new graduates without experience as openings occurrred in the remaining firms. We would foresee a possible technician glut, with Associate degreed people being the last to be hired.

On the other hand, as biotechnology companies, such as AMGen, begin to gear up for production, they will need more workers. A two-year degree with a little microbiology may be exactly what they are looking for. But, again, in order to initiate a biotechnology curriculum there should be a consistent year-to-year demand for its graduates. This has yet to be demonstrated.

1 See questionnaire results on page A32.

2. Product Abstract

This report is the project product. Raw questionnaire data, a large number of periodical articles about biotechnology and other supportive information is available for use by interested parties. Contact the Project Director.

3. Dissemination Activity Summary

A report summarizing the Biotechnology Needs Analysis project has been submitted to the Triton College administration. A copy of the report is also available upon request from the Project Director.

4. Staff Development

Not applicable to this project.

5. Publicity

Not applicable to this project.

PROBLEMS

1. A departure from the original time line was necessary due to the illness of the project director. A consultant was hired to complete the project activities; the budget was formally amended to reflect this change.

2. Information was difficult to get from a number of the companies. Biotechnology is a highly competitive emergent industry. For this reason some firms were reticent to divulge information related to their market planning or activities. However, perseverence on the part of the consultant led to the collection of data which we feel provides accurate representation of projected "biotechnician" employment opportunities.

SUMMATIONS OF EVALUATION DATA COLLECTED

Not applicable to this project.

STATEMENT OF IMPACT

This report will be of assistance to Illinois agencies of higher education and to other educational institutions in the State which have contemplated initiating a similar program. In addition, future reevaluations of biotechnology manpower needs will be facilitated with the industry contacts established through this project.

CONCLUSIONS AND RECOMMENDATIONS

In summary, there are possible positions open in industrial and university settings for people with an Associate's degree in biotechnology. However, the number of jobs is small and the number needed every year may go down.[1] For example, if fifteen students graduated from a biotechnology program the first year and were hired by Biolabs, which needs them, where will the second graduating group of fifteen be employed? Even if there is a turnover rate as high as 50% per year, Biolabs will not need them all and the other companies in Illinois do not want the rest. Cayuga County Community College in Auburn, New York has had a two-year program called Biological Technology for twenty years. They are thinking of terminating the program because the graduates are unable to find jobs.[2] At this point in time a similar program would probably suffer the same fate.

Also, the number of graduates in Illinois from four-year schools in the biological sciences each year is sufficiently high to fill biotechnical positions in Illinois. Graduates from any of the departments listed in the resource section are very good technician candidates. Pasadena City College contemplated starting a two-year cytotechnologist training program. After two years of investigation they decided not to implement the program because California State University at Dominquez Hills already had a four year degree program in cytotechnology and could easily supply southern California's need for cytotechnologists.[3] The Illinois situation with regards to biotechnology is very similar.

There is not much sense in educating students in programs not applicable to employment. The bottom line is to educate students in programs they can use on the job. Because there does not appear to be a consistent demand for technicians with a two-year degree, the development of a two-year degree program in biotechnology is not recommended at this time. The idea should not be dropped entirely, because the industry is very young, with tremendous growth potential.[4] If the growth potential for the industry is realized and if Illinois is successful in luring more biotechnology concerns into the State, a consistent manpower demand may evolve and a two-year biotechnology degree program may be needed. Therefore, this study should be repeated in three to five years to see if the demand for technicians has changed.

Also, as Dr. Roth of ITT pointed out, the term biotechnology, when applied to a two-year degree program, is very misleading, because all of the biotechnology disciplines cannot possibly be covered in two years. If there appears to be an increase in manpower demand in the future, it might be good to specialize the curriculum. One possibility would be a fermentation technologist program.[5] As biotechnology companies gear up fermentation will play a large role. AMGen, for example, will be growing large cultures in industrial fermenters in order to make large quantities of their products. Knowledge of fermentation technics may allow someone to occupy a supervisory position, overseeing production. It would also be applicable to the companies in food and beer industries, such as Kraft, Inc. Future studies should identify the emerging sub-divisions of the larger field called biotechnology when attempting to assess market demand for employees. It is anticipated that clearer subdivisions will have evolved three to five years from now.

1 See page A33.
2 See page A34.
3 See page A35.
4 See page A36.
5 See page A37.

ATTACHMENTS

ATTACHMENTS

	Page
Biotechnology Company Cover Letter	A1
Biotechnology Company Questionnaire	A2 - A6
Questionnaire Results by Company	
Abbott Laboratories	A7
Applied Molecular Genetics (AMGen)	A8
Biolabs, Inc.	A9
Bio-Technical Resources	A10
Consolidated Biotechnology, Inc.	A11
Dow Chemical Co.	A12
GCA/Precision Scientific Group	A13
Kraft, Inc.	A14
Life Technologies, Inc.	A15
Eli Lilly & Co.	A16
Monsanto Co.	A17
Pandex Laboratories, Inc.	A18
Travenol Labs, Inc.	A19
The Upjohn Company	A20
Overall Summary -- Company Questionnaire	A21 - A22
University Department Head Quesitonnaire	A23 - A24
University Reserach Faculty Questionnaire	A25 - A26
Questionnaire Results by University	
Western Illinois University	A27
Illinois Institute of Technology	A28
Northwestern University	A29
University of Illinois at Urbana - Champaign	A30
University of Illinois College of Medicine	A31
Summary of University Questionnaire Data	A32
Number of Possible Openings Available to 2-year Graduates	A33
Cayuga County Community College Biological Tech. Program	A34
Pasadena City College Considered Cytotechnology	A35
Washington University in St. Louis Center for Biotechnology	A36
Rochester Institute of Technology Biotechnology Program	A37
Middlesex County College Biological Lab Tech. Program	A38

Triton College

2000 Fifth Avenue
River Grove, Illinois 60171
(312) 456-0300

School of Career Education

A1

BIOTECHNOLOGY COMPANY COVER LETTER

As briefly discussed in our recent conversation, we are presently attempting to evaluate the manpower needs of researchers, both in industry and academia, for biotechnicians. Your company is listed in the "GEN Guide to Biotechnology Companies" in the November/December 1983 issue of "Genetic Engineering News".

In order for us to properly evaluate the needs of industry for trained people to fill biotechnical positions now and in the future, we need to enlist the help and the cooperation of those people who hire biotechnicians. If you could fill out the accompanying questionnaire and try to return it to me in a week's time, I would be very grateful. Also, if you could include corporate information such as sales, products, etc. it would be very helpful.

Thank you for your time and consideration, and I hope to be hearing from you very soon.

Sincerely,

C. W. Edwards, III
Biotechnology Consultant
Triton College
(312) 456-0300 X[illegible]0

Triton College

2000 Fifth Avenue
River Grove, Illinois 60171
(312) 456-0300

School of Career Education

A2

BIOTECHNOLOGY COMPANY QUESTIONNAIRE

Triton College in cooperation with the Illinois State Board of Education/Department of Adult, Vocational and Technical Education/Research and Development Section is conducting a study to determine the need for a biotechnician curriculum. We ask your cooperation in supplying us with certain information which will aid us in fulfilling the objectives of the study.

1. In what areas of biotechnology is your company involved? (Check all that apply.)
   - ☐ Recombinant DNA (R)
   - ☐ Fermentation (F)
   - ☐ Purification (P) large scale _____ small scale _____
   - ☐ Hybridoma/Cell fusion (H)
   - ☐ Cell/tissue culture (C)
   - ☐ Enzymology (E)
   - ☐ Separation (S)
   - ☐ Sequencing (Q) ☐ Protein ☐ DNA/RNA
   - ☐ Synthesis (Y)
   - ☐ Other: _____

2. What are the educational backgrounds of the people presently working in your company, in each of the areas of biotechnology checked above? Please also indicate the number of people working in each area using the one letter codes from above. (Ex. 5, R = 5 people in Recombinant DNA)

   Ph. D. #, area(s) _____
   Masters #, area(s) _____
   Bachelors #, area(s) _____
   Associate (2 yr degree) #, area(s) _____
   High School (or equiv.) #, area(s) _____

3. Please list the typical entry-level job title(s) for biotechnological employees in your company, with each of the following levels of educational attainment.

   Ph. D. _____
   M. S. _____
   B. S. _____
   A. A. S. _____
   High School _____

A3

4. What is the typical entry-level salary for biotechnological employees in your company, with each of the following levels of educational attainment?

Ph. D. _____
M. S. _____
B. S. _____
A. A. S. _____
High School _____

5. What are the advancement opportunities for the biotechnological employees in your company, with each of the following levels of educational attainment?

Ph. D. _____
M. S. _____
B. S. _____
A. A. S. _____
High School _____

6. For your company, how important is previous biotechnology-related job experience for prospective employees? (Check the spot on the line which best describes your opinion.)

Important ——— Not Important

Comments: _____

7. In your best estimation, how much of an employee's education is utilized on the job?

☐ More than 80% ☐ 50-80% ☐ 20-50% ☐ less than 20%

Comments: _____

8. Does the amount of an employee's education utilized on the job vary according to their degree? ☐ No ☐ Yes

If Yes, how? _____

9. Do you expect to need more biotechnicians ...

... In 5 yrs? ☐ No ☐ Yes, how many?
... In 10 yrs? ☐ No ☐ Yes, how many?

10. If you answered "Yes" to #9, what type of educational backgrounds will you be looking for?

... In 5 yrs? _____

... In 10 yrs? _____

11. What sort of future employee demand do you think there will be in the biotechnology industry as a whole?

☐ High ☐ Medium ☐ Low

For employees in which kinds of jobs? _____

_____

_____

Please consider the following sample curriculum for a two year Associate Degree program in biotechnology:

First Semester	Credit Hours
Biological Principles I or Botany	3-4
General Chemistry I	4
Freshman English I	3
Algebra & Trig	3
Princ. of Effective Speaking	3
	16-17

Second Semester	
Biological Principles II or Zoology	3-4
General Chemistry II	4
Freshman English II	3
Pre-Calculus	3
Contemporary Society	3
	16-17

Third Semester	Credit Hours
Anatomy & Physiology I or Histology	4
Microtechnique	3
Intro to Organic Chem.	4
Technical Physics	4
Programming in BASIC	3
	18

Fourth Semester	
Anatomy & Physiology II or Comparative Vertebrate Ana	4
Microbiology	3
Analytical Chemistry	3
Biotechnology Lab	4
First Aid	2
The Individual and Technology	1
	17

12. Would there be any positions a person who had successfully completed the curriculum described could fill in your company at the present time?

No☐ Yes☐

If Yes, what type of positions and duties would be included?

_____

_____

How many such positions do you now have? _____

13. Do you expect that there will be any positions a person who had successfully completed the curriculum described could fill in your company in the future?

No☐ Yes☐

If Yes, what type of positions and duties would be included?

_____

_____

How many such positions would you anticipate having three years from now? _____ Five years from now? _____

14. If you now have or expect to have positions for persons in which the above training might be appropriate, would you make any changes in the sample curriculum above?

No☐ Yes☐

If Yes, what changes would you make? _____

_____

_____

_____

15. Including your recommended changes (if any), do you think there will be a demand for people, with the 2 year associate degree qualifications described above, in the biotechnology industry as a whole?

No☐ Yes☐

If Yes, when? _____

16. If an Associate Degreee program such as the one described were available, would your answer to question #10 on page 3 remain the same? If not, how would it change?

Yes☐ No☐ How? _____

_____

17. Do you know of any colleges awarding bachelors or associates (2 yr) degrees in "biotechnology"?

No☐ Yes☐

If Yes, please write in name(s) and locations(s) of those college(s):

_____

_____

_____

18. Any additional comments are very welcome.

_____

_____

_____

_____

Name of person Filling Out this Questionnaire

_____ ( ) _____

Title Phone

_____

Company Name

Thank you very much for taking the time to respond to this questionnaire. If it is at all possible to include with this questionnaire any job descriptions, including duties, for the biotechnical or related positions in your company, it would be very much appreciated. They will help us in interpreting your responses. Thanks again, and I will inform you of any decisions we make.

Sincerely,

C. W. Edwards, III
Biotechnology Consultant
Triton College
2000 Fifth Avenue
River Grove, Illinois 60171
(312) 456-0300 X630

Abbott Laboratories
Abbott Park
Abbott, Illinois 60064 (312)937-6100
Contact Person: Susan Hart-Wadley, Corporate Recruiter

Abbott Laboratories is involved in research in all of the areas of biotechnology outlined in the questionnaire. There are well over two hundred people working in these areas and nearly all of them possess a four-year degree or better. They expect to need more people in the future and they also expect this of the biotechnology field as a whole. As for Abbott, they are definitely not interested in hiring a technician with only a two-year degree. Ms. Hart-Wadley believes the sample curriculum as outlined in the questionnaire should be expanded to a four-year program.

Abbott joins the ranks of Kraft, Eli Lilly, Upjohn, Miles, and Travenol as large biotechnology companies unwilling to hire people with only a two-year degree. These large concerns will have most of the job openings in biotechnology in the future and their unwillingness to hire people with an Associate's degree makes it unlikely graduates from a two-year program would be able to find a position in industry.

Company Profile

Employment: 32,100
Sales per annum: approx. $2.6 billion
Markets: chemical, agriculture, health care, diagnostics, hospital products, pharmaceuticals.

Applied Molecular Genetics (AMGen)
1900 Oak Terrace Lane
Thousand Oaks, California 91320 (805)499-5725
Contact Person: Susanne Hersh, Personnel Manager
Founded: April 1980

AMGen is currently involved in the following areas of biotechnological research: recombinant DNA, fermentation, purification, hybridoma/cell fusion, cell/tissue culture, macromolecular sequencing, and synthesis. Of the fifty-eight biotechnical workers currently employed, twenty-six have Doctoral degrees, 18 have Masters degrees eleven have Bachelors degrees, and three are high school graduates. Entry level salaries range from $12,000 per year for high school graduates to $38,000 per year for Doctorates, with Associate degreed personnel starting at $14,000 per year.

AMGen is currently experiencing rapid growth and Ms. Hersh indicates they may need twenty to thirty additional biotechnicians in the next five to ten years. Ms. Hersh also said there were sixteen positions open at the present time for people with an Associate's degree given the sample curriculum outlined in the questionnaire. Advancement opportunities for these people can be excellent, depending on the individual's performance and length of tenure at AMGen. The duties of these individuals would include media preparation, general animal care, routine analyses for standard laboratory procedures, compile and maintain information from results of analyses, prepare reagents and chemical solutions, and perform surgical procedures on animals.

Although AMGen is opening a facility in Chicago's new High Tech Park, the sixteen positions for people with an Associate's degree would probably be at the California facility. This may change once the Chicago facility is in high gear.

Ms. Hersh believes there will be a medium to high demand for technicians in the field of biotechnology as a whole. She also feels there will be an industry-wide demand for people with an Associate's degree. This demand may vary with time from one company to another, but it may be felt in the immediate future.

Company Profile

Employment: 90
Sales per annum: Approx. $3 million
Founded: April 1980
Markets: biological, pharmaceutical, diagnostics, veterinary, chemical
Products: recombinant indigo, chicken growth hormone, interferon
Joint ventures: Kirin Brewing Co. Japan
Abbott Laboratories Chicago

Biolabs, Inc.
2910 MacArthur Blvd.
Northbrook, Illinois 60062 (312)498-6020
Contact Person: Dr. Clyde R. Goodheart, President
Founded: 1969

Their areas of biotechnology are hybridoma/cell fusion, cell/tissue culture, and separations. Currently, three research assistants with Bachelor's degrees are working in the cell/tissue culture area and one technician with an Associate's degree is working in separations. There is no information regarding the people involved in the hybridoma/cell fusion area. Hybridoma research is a new area and it is doubtful if someone with an Associate's degree is working in this area. Current products are tissue culture supplies - e.g. media, growth additives, etc.

The growth rate of Biolabs, Inc. hinges on the success of their tissue culture reagents. Dr. Goodheart indicates, though, that there may be as many as 20 positions for biotechnicians available within the next 5 years. Not all of these positions would be open for people with only an Associate's degree, but at least 15 of the positions would be open for Associate degrees. The starting salary for an Associate degree can be expected to range from $13,000 to $14,000.

Dr. Goodheart responded favorably to the sample curriculum as it appeared in the questionnaire. He said it would be an excellent background for someone in his company because of the emphasis on chemistry. Knowledge of chemistry is essential for preparing accurate solutions and reagents. Dr. Goodheart also felt there would be a high demand for biotechnicians in the future, and a demand for technicians with an Associate degree in 2-3 years.

Company Profile

Employment: 10
Sales per annum: Not available
Founded: 1969
Markets: biologicals, pharmaceuticals
Products: tissue culture supplies

Bio-Technical Resources
7th & Marshall Streets
Manitowoc, Wisconsin 54220 (414)684-5518
Contact Person: Dr. Thomas J. Skatrud, Ph.D., Research Director, (Vice President)
Founded: 1962

Biotechnical Resources' areas of work in biotechnology are fermentation and enzymology. These disciplines are interconnected and currently there are 3 Ph.D.'s (biochemistry), 5 M.S's (microbiology, biochemical engineering), 14 B.S.'s (chemistry, biology, micro, etc.) and one Associate degreed person working for the company.

Dr. Skatrud indicated his company may need 3-5 more technicians within the next 5 years with backgrounds in microbiology, biochemistry, and food technology. Their need for technicians beyond that is hard to tell. These positions will not be open to people with Associate degrees with the curriculum in the questionnaire because, "the biological sciences will require better mathematical background in future. In our line of work, we've found the 4 year degree critical even at the lab tech level. (Primarily due to internal training costs for individuals with Associate degrees.)" Dr. Skatrud also said he expects a medium demand for technicians in the biotechnology field as a whole in the future, and people with an Associate degree with a better math background may fill some positions in production and possibly quality control.

Company Profile

Employment: approx. 25 in research
Sales per annum: Not available
Founded: 1962
Markets: biological, pharmaceutical, agriculture, food processing, pesticides, chemicals, minerals, plastics, malting and brewing
Products: mono-and dibasic acids, detergent proteases, polysaccharides, plant growth regulators, sterols, low carbohydrate beer, concentrated flavors, vitamins, coffee substitutes, microbial leaching chelators

Consolidated Biotechnology, Inc.
1413 West Indiana Avenue
P.O. Box 2086
Elkhart, Indiana 46515 (219)295-6767
Contact Person: Dr. J. John Marshall, Ph.D., President
Founded: August 1983

As can be seen from the above, Consolidated Biotechnology, Inc. is a very young company. Dr. Marshall appears to be very busy and may not be able to fill out the questionnaire within the time remaining for this project. Other services for information will have to be utilized.

From the November/December issue of Genetic Engineering News, Consolidated Biotechnology, Inc. is privately held and is involved with enzymology, fermentation, separation and lab-scale purification. Their major products are research biologicals.

Company Profile

Employment: Not available
Sales per annum: Not available
Founded: August 1983
Markets: biological, diagnostics, chemical test, food processing, pharmaceutical, veterinary, agriculture, chemicals, biomass, fuels
Products: research biological

Dow Chemical Co.
2030 Dow Center
Midland, Michigan 48640 (517)636-1000
Contact Person: Dr. Carol C. Epstein, Midwest & Ph.D. Recruiting Manager
Founded: 1897

Dow Chemical Company is involved in the following areas of biotechnological research: recombinant DNA, fermentation, purification, cell/tissue culture, enzymology, separation, and nucleic acid sequencing. The current thrust of their research centers around recombinant DNA and fermentation technics with plans for expanding in the tissue culture area in the future. There are a total of twenty-three individuals working in these fields, of which there are thirteen Ph.D.'s, three M.S.'s, six B.S.'s, and one Associate degree individual.

Employee salaries at Dow are higher than average for people in biotechnology with a starting salary of $19,200 per year for and associate's degreed individual. Advancement opportunities for this type of person are limited to yearly salary adjustments. Dr. Epstein indicated Dow would need one or two technicians with an ssociate's degree each year for the next five years, and perhaps four to five per year after that. The successful ssociate degreed job applicant will have to possess skills in bioanalysis, standard research procedures, data collection and presentation, and report writing. Dow Chemical and Monsanto are the only two large companies surveyed who have expressed sincere interest in hiring people with an ssociate's degree and only Dow is satisfied with the proposed curriculum as set forth in the questionnaire. Dr. Epstein believes, however, in the next three to five years other companies may be willing to hire people with an ssociate degree with an increasing demand for such people subsequently.

Company Profile

Employment: 56,600 worldwide
Sales per annum: Approx. $10.6 billion
Founded: 1897
Manfacture: industrial inorganic and organic chemicals, plastics, pharmaceutical preparations, biological products, medicinal chemicals, and botanical products.

GCA/Precision Scientific Group
3737 Cortland Street
Chicago, Illinois 60647 (312)227-2660 X525
Contact Person: Robert S. Rhine, Business Manager

Their areas of concern in biotechnology are hybrdoma/cell fusion, recombinant DNA, and cell/tissue culture. Their major product is Zimmerman Electrofusion™ System which uses an alternating current to fuse two cell types. They have 4 Ph.D.'s working in hybridoma/cell fusion, recombinant DNA, and cell/tissue culture; 1 M.S. in recombinant DNA, hybridoma/cell fusion, and cell/tissue culture; 4 B.S.'s in recombinant DNA, hybridoma/cell fusion, and cell/tissue culture. (These fields overlap.)

Mr. Rhine indicated their need for biotechnicians in the future "depends on the success of our current products and the new products we develop." If all goes well they will need people with backgrounds in microbiology, tissue culture, and biochemistry. As for the industry as a whole, he expects a high demand for biotechnicians because, "the product potential for bio-tech produced products is very high and therefore the industry will demand a wide range of varied employees, from technicians to Ph.D.'s."

The sample curriculum as set forth in the questionnaire would be adequate for the one open position of lab technician right now, and there may be openings for as many as 5 more in five years. As for the industry as a whole Mr. Rhine believes there is a need now for people with an Associate degree. However, he also added that he thought "a 4 year degree, with more effort towards actual lab work," would provide a better background for a lab person in biotechnology.

Company Profile

Employment: approx. 10 in research
Sales per annum: Not available
Founded: 1980
Markets: biological, pharmaceuticals, diagnostic, clinical tests, veterinary, agriculture, food processsing, pesticides, chemicals, biomass, toxic waste processing, fuels, minerals.
Products: Zimmermann Electrofusion™ System
Subsidiary of GCA Corporation

Kraft Inc.
Kraft Court
Glenview, Illinois 60025 (312)998-2000
Contact Person: Mildred J. Clark, Administrative Coordinator
Founded: 1903

Kraft Incorporated has about 500 people involved in research at present. They are looking for someone to head up a Genetic Engineering project for the development of phage resistant starter cultures. Since this project has not started there is no way of telling how large it will be or for how long it will run. Consequently manpower needs cannot be determined now.

From previous contacts through Lois Pye it has been learned Kraft does hire people with Associate degrees as laboratory technicians. These people work in established areas of routine chemical analyses and operation and assembly of equipment in processing areas and maintenance of equipment and work areas. According to Ms. Clark when openings occur within the new Genetic Engineering department, a person with the training acquired through the sample curriculum provided in the questionnaire would not be hired. They will require more knowledge in biochemistry and microbiology. More information will become available when the questionnaire is returned.

Ms. Clark returned the questionnaire as promised. She did not fill it out and she did not say who did. There could be some (1-2) positions open for someone with an Associate's degree in the next three to five years. However, changes in the sample curriculum would have to be made. Additional courses in microbiology and biochemistry would have to be added to the curriculum before a graduate of the program would be considered. If these changes can be made Kraft feels there would be a demand for Associate degree people in the biotechnology field as a whole within the next five years.

Company Profile

Employment: 47,400 (500 in research)
Sales per annum: approx. 6.5 billion
Founded: 1903
Products: dairy products and processed foods

Life Technologies, Inc.
P.O. Box 200
Chagrin Falls, Ohio 44022 (216)247-4300
Contact Person: Joyce Coleman, Corporate Manager
Founded: September 1983 - Merger of Gibco and BRL

Ms. Coleman forwarded the questionnaire to Gibco/BRL Laboratories Division, Gaithersburg, MD 20377 for completion. The identity of the person who filled out the questionnaire is not known. Life Technologies Inc. is involved in all of the areas of biotechnology as listed in the questionnaire. There are currently 27 Ph.D., 17 M.S., 54 B.S., and 2 AAS degreed personnel working for the company. Of the two Associate degreed people, one works with recombinant DNA technologies and one work in quality control. The entry level job title for someone with an Associate degree is laboratory technician with a starting salary of $12,646 per year. Advancement opportunities are excellent and are based on ability and not educational degrees. Previous industrial experience is desired but most candidates lack it.

Future manpower demands will depend on the growth of the industry and the particular company. Life Technologies, Inc. will be looking for more people with B.S. degrees in the next five years. They would not be interested in hiring someone who had successfully completed the sample curriculum in the questionnaire and they do not believe there will be a demand for people with an Associate degree in the industry as a whole. Also, they anticipate a medium demand for biotechnicians in the industry. One reason they cited for only a medium employee demand is because of an anticipated "shaking out" occurring in the industry. When the "shaking out" of the biotechnology industry occurs some companies will fold and others may consolidate their resources and products. The end result of "shaking out" will be a reshuffling of technicians from folding or shrirking companies to growing companies. People with experience will have an advantage over recent graduates in securing new openings, and people with a recently attained Associate degree may very well be closed out of the market.

Company Profile

Employment: 1,500
Sales per annum: approx. $100 million
Founded: 1983 - merger of Gibco and BRL
Markets: biological, diagnostics, agriculture, chemicals, energy
Products: media, diagnostic test kits, recombinant DNA reagents, monoclonal antibodies, electrophoresis systems

Eli Lilly & Co.
307 E. McCarty Street
Indianapolis, Indiana 46285 (317)261-2000
Contact Person: John W. Crooks, Manager College Relations
Founded: 1876

Eli Lilly & Company's areas of research in biotechnology include all those listed in the questionnaire. The specific areas of research to be conducted at the $60 million, 300,000 square feet biomedical research facility (planned opening fall 1984) will include: osteoarthritis and inflammatory disease research; pulmonary research; monoclonal antibody research including immunology, Immunochemistry and hybridoma research; cell biology and recombinant DNA research including bio-engineering, mammalian cell culture, eukaryotic expression vectors, molecular biology and molecular genetics, and oncogene research (see ad in Science Magazine, March 30, 1984).* Positions available at the new biomedical research facility are restricted entirely to Ph.d., M.S. and B.S. degrees. This is probably because the facility will be involved with pure and not applied research.

In other areas of the company very few Associate degrees are employed; those that are hired are hired as technicians. These positions are in the production of established product lines and require very little prior technical training. Mr. Crooks indicated the sample curriculum in the questionnaire is not applicable to Lilly because they do not hire Associate degrees for research. No salary information for those Associate degrees hired or their qualifications for hiring them was available.

Eli Lilly & Co. may very well be the model for large biotechnology companies. They have high powered pure research departments from which future products are developed. These products are developed to such a point that when they go into full scale production a very limited number of skilled people are required as supervisors with the bulk of production carried out by unskilled workers in a factory atmosphere. This would make an Associate degree in biotechnology unattractive because as projects come to a close and new ones are initiated people with Associate degrees would require more retraining than Bachelors or Masters degrees because of their more narrow educational background.

Company Profile

Employment: 29,000 Founded: 1876
Sales per annum: approx. $3.0 billion
Products: human medicines, electronic medical instruments, agricultural products, and cosmetics

* Included in the attachments to this report.

Monsanto Co.
800 N. Lindbergh Blvd.
St. Louis, Missouri 63167 (314)694-100
Contact Person: Dr. Dale Fox
Founded: Began biotechnology endeavors in 1979

Monsanto Co. is involved with all of the fields of biotechnology as listed in the questionnaire. There are currently about 75 Ph.D., 15 M.S., 80 B.S., and 10 AAS personnel working in the various areas. Dr. Fox believes previous biotechnology-related job experience is very important, especially for people with an Associate's degree. People with Associate degrees basically have a chemistry background which is better used in the petrochemical industry. Biotechnology experience could be gained during the Associate degree program if it included some microbiology and biochemistry, with laboratory work in each. Dr. Fox indicated Monsanto is currently looking for people with Associate degrees with experience. There are 8 such openings now and there could be 10 more within the next five years and possibly more in 10 years.

Dr. Fox kept stressing the importance of including microbiology and biochemistry in an Associate degree curriculum. It is also important to include as much hands-on experience as possible through laboratory courses. Dr. Fox would certainly consider applicants with this type of educational background.

Monsanto Company is bucking the trend noticed from the responses from other large biotechnology concerns such as Eli Lilly & Co., The Upjohn Co., and Kraft Inc. These latter companies feel they need people with at least a Bachelor's degree and preferably an advanced degree. Kraft and Monsanto both have indicated a need for microbiology and biochemistry in an A.A.S. curriculum. Introductory courses in both areas could probably be offered with laboratory courses following. There may even be a possibility for summer internships with various companies or researchers at local universities. A problem that could arise, however, is that introductory courses may be insufficient in their scope.

Company Profile

Employment: 51,000
Sales per annum: approx. 6.5 billion
Founded: began biotechnology endeavors in 1979
Products: chemicals, plastics, agricultural products, man-made fibers, specialized electronic and process control systems

Pandex Laboratories, Inc.
909 Orchard Street
Mundelein, Illinois 60060 (312)949-6700
Contact Person: Dr. Michael E. Jolley, Ph.D., V.P. R&D
Founded: 1982

Pandex is currently involved in the following areas of biotechnology: recombinant DNA, purification, hybridoma/cell fusion, cell/tissue culture, separation, synthesis, and instrumentation/immunoassay. They have people with Ph.D., M.S. and B.S. degrees working for them but there are no people with A.A.S. degrees working in the technical end of the company. Entry level salary depends on experience but previous industry related experience is not important for prospective employees. They expect to need more employees within the next five years but they will be looking for people with four-year and advanced degrees. Pandex will not and has no desire to hire people with an Associate degree, but they feel there may be a need for Associate degree technicians in the industry as a whole. Pandex specifically needs people with training in immunology and/or molecular biology, tissue culture, and biomedical engineering.

Company Profile

Employment: Not available
Sales per annum: Not available
Founded: 1982
Market: chemical
Products: fluorometric immunoassay analyzer for hybridoma screening

Travenol Labs Inc.
Route 120 & Wilson Road
Round Lake, Illinois 60073 (312)546-6311
Contact Person: Mike Umphres
Founded:

The facilities of Travenol Labs in Illinois do not use any of the biotechnologies listed in the questionnaire for research purposes. At their Glenview facility they do use tissue culture technics to conform to FDA regulations for product assurity. Mr. Umphres said they do not nor would not hire people with a 2 year degree because of the ever changing thrust of their work.

Travenol is working jointly with Genentech in Boston on projects in biotechnology. There are no jobs with Travenol in Illinois for biotechnicians. Because of that, Mr. Umphres felt it was a waste of his and my time to fill out the questionnaire and I had to agree.

Company Profile

Employment: 29,000
Sales per annum: approx. 2.0 billion
Founded: 1931
Markets: medical care products

The Upjohn Company
7000 Portage Road
Kalamazoo, Michigan 49001 (312)323-4000
Contact Person: Lance D. Williams, Employment Rep.
Founded: 1886

The Upjohn Company is currently conducting research in all of the areas of biotechnology outlined in the questionnaire. Mr. Williams did not feel it was relevant to participate in our survey because they presently need people with a minimum of a four-year degree. He also said they currently prefer people with Masters and Ph.D. degrees than Bachelor degrees. Technician positions are usually filled from within the company. They look for people with a high school education with a preference for people who have some college level science courses. These people, it appears, must already be employed by Upjohn in positions equivalent to factory line positions e.g. pill press operators, sorters, packagers, etc. These people are given significant on-the-job training.

The correspondence from Mr. Williams supports the comments made in the Eli Lilly & Co. report. Upjohn's research and development concerns require the broad science backgrounds afforded by four year and advanced degrees. Production is carried out largely by untrained personnel. These production people must therefore make up a significant portion of Upjohn's 12,000 U.S. employees.

Company Profile

Employment: 21,200 (12,000 in U.S.)
Sales per annum: approx. 1.9 billion
Founded: 1886
Products: ethical drugs, bulk pharmaceuticals, polyurethane, fire chemicals, seed, veterinary, plant, and animal health care products, diagnostic laboratory testing and paramedical help medical services, and broiler brood stock.

SUMMARY
BIOTECHNOLOGY COMPANY QUESTIONNAIRE DATA

1. Who? What?	Clyde Goodheart Pres., Biolabs, Inc. H,C,E*	John Cronka Mgr., Eli Lily & Co. R,F,P,H,C,E,S, Q,Y	Thomas Skatrud V.P, Bio-Technical Resources, Inc. F,E	Robert Shine Bus. Mgr. GCA/ Precision Scientific R,H,C	Kraft, Inc.	Dr. Dale Fox Monsanto R,F,P,H,C,E, S,Q,Y	Lance G Williams Upjohn R,F,P,H,C,E,S, Q,Y	Life Technologies R,F,P,H,C,E,S, Q,Y
2. Education of Workers	Ph.D. M.S. B.S. 3, C A.A.S. 1,S H.S.	Ph.D.) Many at M.S. } Each B.S.) Level A.A.S.) Very H.S. } Few	Ph.D. 3; F,E M.S. 5; F,E B.S. 14; F,E A.A.S. 1; F,E	Ph.D. 4; R,H,C M.S. 1; R,H,C B.S. 4; R,H,C A.A.S. H.S.	----	Ph.D. 75 M.S. 15 B.S. 80 A.A.S. 10 H.S. None	----	Ph.D. 27 M.S. 17 B.S. 54 A.A.S. 2 (1R, 1QC)
3. Entry Level Job Titles	Ph.D-Scientist M.S.-Research Assoc. B.S.-Res. Asst. A.A.S.-Tech. H.S.-Tech.	Ph.D-Senior Molecular Biologist M.S.- " B.S.-Assoc. Molecular Biologist A.A.S. Tech. H.S. Tech.	Ph.D-Research Scientist M.S.- " B.S.-Lab Tech A.A.S.- ---- H.S.- ----	Ph.D-Senior Scientist in Applications Lab M.S.- ---- B.S.-Sales Rep. Scientist A.A.S.- ---- H.S.- ----	----	A.A.S.- Technician	----	Ph.D-Scientist M.S.-Biochemist B.S.- " A.A.S.-Technician H.S.- "
4. Entry Level Salary	Ph.D-$35-40K M.S.-$25K B.S.-$14-16K A.A.S.-$13-14K H.S.-$10K	Ph.D-$35-40K M.S.-$22-24(B.S.-$20-21K A.A.S.-) N/A H.S.- }	Ph.D-$23-24K M.S.-$15-20K B.S.-$13-16K A.A.S-) N/A H.S.- }	Ph.D-$30K M.S.- --- B.S.-$20K A.A.S.-$15K H.S.- ---	----	----	----	Ph.D-$24,106 M.S.-$17,460 B.S.-$14,960 A.A.S.-$12,644
5. Advancement Opportunities	Ph.D- Res. Mgt. M.S.- Res. Mgt. B.S.- ?Indus. or Sales A.A.S.- ?Salary H.S.- ?Salary	Ph.D-Unlimited M.S.-) Depends B.S.-) on Advance Degree & Work Performance A.A.S.-) N/A H.S.- }	Ph.D-Into project Mgt. M.S.- " B.S.-Group Leader A.A.S.-) N/A H.S.- }	Ph.D-R&D Director, Applications Lab Mgr. M.S.- --- B.S.-Senior Sales Rep/ Senior Scientist A.A.S.- ---- H.S.- ----	----	----	----	"Excellent! Opportunities are based on ability not educational degree."
6. Importance of Experience	1.2-Want people w/enough so they can learn how.	2.7-Ph.Ds through a postdoctorate; BS/MS through lab experience	2.0-Depends on Position	3.0-	1.8	5.0-Need Biotech experience	----	4.0-"However, previous experience in industry is not prevalent.
7. % Education Utilized	More than 80%	More than 80%	50-80%	20-50%	50-80%	50-80%	----	50-80%
8. ~~% Same~~ for All Degrees?	Yes	Yes Probably More Useful at Ph.D	Yes Depends on Training	Yes	Yes	No	----	Yes. "The more advanced the education, the greater percentage utilized on the job."
9. Need more Biotechs? 5,10 yrs?	5 yrs. Y-20 10 yrs. Y-??	5 yrs. Y-? 10 yrs. Y-?	5 yrs. Y-3-5 10 yrs. ?	5 yrs. Y-? 10 yrs. Y-?	5 yrs. Y-? 10 yrs. ?	5 yrs. Y-10 10 yrs. ?	5 yrs. Y-? 10 yrs. Y-?	5-10 yrs. Yes depends on growth of the industry and particular company
10. Future Education Needs	As in #6	Same as we are currently seeking	5 Yrs.-Microbiology, Biochemistry, Food Technicial 10-yrs Hard to Tell	5-yrs.-Microbiology, Tissue Culture, Biochemistry 10 yrs.-Same	Microbiology Biochemistry 5&10 yrs.	5&10 yrs.-AAS w/Microbiology & Biochemistry Backgrounds	M.S. & Ph.D Some B.S No A.A.S.	5 yrs more B.S.
11. What Demand for Whole Industry?	High	High	Medium	High	High	High	High	Medium-Entry & middle level positions in Mfr., perhaps some R&D, depends on consolidation & "shakeout"
12. A.A.S. Openings	No openings at present	N/A We don't hire A.A.S.	No	Yes Lab Technician	No	Yes-8	No	No
13. A.A.S. Openings, Future?	Y-Production 3 yrs-15 5 yrs-30	No	No	Yes-Lab Tech 3 yrs-2 5 yrs-5	Yes Technicians & Assistants 3 Yrs-1-2 5 Yrs-2	Yes-10 within 2 yrs.	No	No
14. Make Changes in A.A.S.?	No; looks like excellent background	No	Yes; Biological Sciences will require better math background	Yes	Yes, additional courses stressing Microbiology and Biochemistry	Yes, Microbiology, Biochemistry, Stress Lab Work	No (N.A)	N.A.
15. Demand? When?	Y- 2-3 yrs.	Don't Know	Yes	Yes- Now	Yes- Within 5 yrs.	Now	Maybe	No
16. Change Answer to #10?	No; need chemistry for solution mixing	Don't Know	No	No	No	No	No	No
17. Known Changes	None	Not Sure	No	No	No	No	No	No
18. Comments	"Sounds like you're on the right track."		See #14			They are looking for people with Micro and Biochemistry	Looking mostly for M.S. & Ph.D.	----

* Technologies used:
R Recombinant DNA
F Fermentation
C Cell/Tissue Culture
E Enzymology
S Seperations

BEST COPY

BEST COPY AVAILABLE.

SUMMARY (CONTINUED)
BIOTECHNOLOGY COMPANY QUESTIONNAIRE DATA

1.	What? What?	M.E. Jolley Ph.D V.P. R&D Pandex Labs, Inc R,P,M,C,S,Y Instrumentation Immunoassay Too Confidential	Susan Hart-Wadley Corp. Recruiter Abbott R,F,P,M,C,E,S, Q,Y	Susan Hersh Personnel Mgr. Amgen R,F,P,M,C,Q,Y	Carol C. Epstein Ph.D. Dow Chemical R,F,P,C,E,S,Q	Totals 9R, 8F, 8P, 9M, 10C, 7E, 8S, 7Q, 7Y
2.	Education of Workers		Over 200 Ph.Ds Many M.S. & B.S.	Ph.D-26 total M.S.-18 " B.S.-11 " M.S.- 3 No A.A.S.	Ph.D-73 M.S.- 3 B.S.- 6 A.A.S.- 1	Ph.D greater than 400 M.S. greater than 10 B.S. greater than 200 A.A.S. approx. 20 M.S. less than 5
3.	Entry Level Job Titles	Ph.D-Senior Scientist M.S.-Scientist B.S.-Research Associate A.A.S.-None	Ph.D-Biochemist Immunologist Microbiologist M.S.-Same B.S.-Lab/R&D Technician	Ph.D-Research Scientist M.S.-Research Assoc. II B.S.- " I A.A.S.-Lab Assist II M.S. Lab Assist I	Gr. Res._____ Res. _____ _____ Technologist	Consensus Ph.D-Scientist M.S.-Research Associate B.S.-Research Assistant A.A.S.-Laboratory Technician M.S.-Laboratory Assistant
4.	Entry Level Salary	Varies with Experience	Ph.D-$33,000 M.S.-$24,000 B.S.-$19,200	Ph.D-$38,000 M.S.-$20,000 B.S.-$18,000 A.A.S.-$14,000 M.S. $12,000	Ph.D-$33,600 M.S.-$30,000 B.S.-$26,400 A.A.S.-$19,200	Average Ph.D-$32,400 M.S.-$22,400 B.S.-$18,600 A.A.S.-$14,900 M.S.-$11,000
5.	Advancement Opportunities	Ph.D-Director M.S.-Senior Scientist B.S.-Scientist	Ph.D-Mgt. Track or Sci Ladder M.S.-2 Grade Levels B.S.-3 Grade Levels			Max. Advancement Ph.D-Management M.S.-Senior Scientist B.S.-Scientist A.A.S.-Research Associate M.S.-Research Assistant
6.	Importance of Experience	1.0	4.0	3.9	2.7	Average 5.0-Very Important 1.0-Not Important 2.85
7.	% Education Utilized	20-50%	20-50%	50-80%	50-80%	Approx. 80%
8.	#7 Same for All Degrees?	No	No	No-Dependant on the type of degree and what add'l. training is required.	No, Ph.D. 100%	Yes
9.	Need more Biotechs? 5,10 yrs?	B.A., M.S., Ph.D (5 yrs.) Yes	5 yrs.-Yes 10 yrs.-Yes	Yes 5 yrs.-20 10 yrs-30	Yes 1-2/yr Next 5 yrs. Maybe 4-5/ yr. after that	5 years approx. 80% 10 years ?
10.	Future Educational Needs	Same as #9	Biochemist, Mol. Biol., Organic Chem, Micro, 10 yrs. Chem. Engineer	Ph.D. M.S. B.S. A.A.S.	5 yrs Bioanalytical skills; std. res. proc. 10 yrs Bioengineering skills	Most positions will be filled by people with B.S., M.S., or Ph.D. degrees
11.	What Demand for Whole Industry?	High All Jobs	Medium	Medium to High. Protein Chemistry Fermentation Chem Eng.	Medium Gen. Engineer Prot. proc. Mammalian Cell Culture	Medium to High Demand for industry as a whole.
12.	A.A.S. Openings	No	No	Yes Now-16	Yes 1-2/Year	Yes, Approximately 25
13.	A.A.S. Openings Future?	No	No	Yes	Yes 1-2/year See #9	3 years greater than 25 5 years greater than 25
14.	Make Changes in A.A.S.?	No	Yes; Make it 4 yrs.	No	Make sure there is enough lab work to develop data collection & report writing.	More Microbiology More Mathematics Maybe some Biochemistry
15.	Demand? When?	Yes	No	Yes, varies with company	Yes- 3-5 yrs.	Yes- 3-5 years
16.	Change Answer to #10?	No	No	No	No	No
17.	Known Colleges	No	U of Maryland @ Baltimore; San Diego State	Yes, Rochester Inst. of Tech	Mich. Tech-Ind. Chem; 2 Biotech options	U. of Maryland, Baltimore Rochester Institute of Technology San Diego State
18.	Comments	Need people with training in immunology and/or molecular biology, tissue culture and biomedical engineering	---			

BEST COPY

DEPARTMENT HEAD QUESTIONNAIRE

Microbiology and biology depts.
Biochemistry depts.
Mol. Biol. depts.

1. In which of the following biotechnology areas are researchers in your department working?

A. Molecular biology _____Yes _____No
If "yes", 1) procaryotic molecular biology ____Yes ____No
2) eukaryotic molecular biology ____Yes ____No
If "yes", ____yeast ____plant ____mammalian
3) macromolecular sequencing ____Yes ____No
If "yes", ____protein ____DNA ____RNA
4) macromolecular synthesis ____Yes ____No
If "yes", ____protein ____DNA ____RNA
5) Other: _____

B. Enzymology _____Yes _____No

C. Immunochemistry _____Yes _____No
If "yes", 1) hybridomas involved? ____Yes ____No
2) protein sequencing? ____Yes ____No

D. Cellualar Immunology _____Yes _____No
If "yes", 1) hybridomas involved? ____Yes ____No
If "yes", ____B-cell ____T-cell

E. Virology _____Yes _____No
If "yes", 1) bacteriophages ____Yes ____No
2) animal viruses ____Yes ____No
3) plant viruses ____Yes ____No

F. Bacteriology _____Yes _____No

G. Cytology _____Yes _____No
If "yes", ____prokaryotic ____eukaryotic

H. Physiology (cell) _____Yes _____No
If "yes", ____prokaryotic ____eukaryotic

I. Fractionation _____Yes _____No
If "yes", 1) membrane components ____Yes ____No
2) cell wall components ____Yes ____No
3) cytosol components ____Yes ____No

2. Does your department, as opposed to individual faculty members, employ any full time technicians?
If "yes", how many?_____
What are their duties? _____
_____
_____
approximate salary _____
minimum level of education _____

3. Do any of your faculty employ full time technicians for research purposes? _____Yes _____No
If "yes", how many? _____

4. Do any of your faculty employ full time assistants for purposes of media-reagent preparation, lab ware cleaning, or sterilization?
_____Yes _____No
If "yes", how many? _____

5. Could you provide me with the names of 3 faculty members, and their general area of research, who hire full time technicians and/or assistants for further information?

1) _____

2) _____

3) _____

Thank-you very much for your time and cooperation. I'll let you know how and what final decision you have helped us reach concerning our biotechnology program.

Biotech Needs Analysis

Research Faculty Questionnaire

Name _____

University _____

Department _____

Phone Number _____

Area(s) of reseach _____

_____

_____

1. How many technicians do you currently employ? _____

2. What are their duties? _____

_____

_____

3. What are their educational backgrounds? _____

_____

_____

4. What are their salaries? _____

_____

Are they paid with grant funds? _____ Yes _____ No
Are there provisions for salary increases in the grant? _____ Yes _____ No
Do you foresee any future funding difficulties? _____ Yes _____ No _____

_____

5. How long does it usually require to train a recently hired technician to perform their duties? _____

_____

6. How many technicians have you employed in the last 5 years? _____

7. What are the minimum credentials an applicant must have for you to consider them for a position in your laboratory? _____

_____

_____

_____

8. If you had the opportunity to structure a 2-year career-oriented program whereby a successful graduate could work in your laboratory, what would you include? _____

_____

_____

_____

_____

9. Given a 2-year career-oriented program in "biotechnology" compatible with your needs, would you hire one of its graduates over a graduate of a 4-year program?
_____ Yes _____ No Why or why not? _____

_____

_____

10. Even if a graduate of a 2-year biotechnology program could not work in your laboratory, do you think there will be a demand for them in the field as a whole?
_____ Yes _____ No If "yes" when? _____

If "No" why not? _____

_____

_____

Thank you very much for your time and cooperation. I'll let you know how and what final decision you have helped us reach concerning our biotechnology program.

Date of Interview: _____

Department of Biological Sciences
College of Arts and Sciences
Western Illinois University
Macomb, Illinois 61455 (309)298-1546
Contact Person: Dr. Benton H. Stidd, Chairperson

Research in the Department of Biological Sciences involves few areas of biotechnology. There is some research in eukayotic cytology and physiology, as well as bacteriology. The department itself does not have any full-time technicians on staff and some researchers periodically hire technicians depending on the grant they are working within. This indicates those few technician openings do not have much longevity and are subject to the duration of the grant as well as the reserchers ability to renew exisitng grants. The Department of Biological Sciences would not be a good source of biotechnical job opportunities.

Department of Biology
Lewis College of Sciences and Letters
Illinois Institute of Technology
Chicago, Illinois 60616 (312)567-3481
Contact Person: Dr. Robert M. Roth, Chairman

Dr. Roth gave me more information relevant to an Associate degree program in biotechnology through conversation, than he could have through the questionnaires. The Department of Biology at IIT has graduate level courses in biotechnology but Dr. Roth is not sure a biotechnology curriculum would work even at the Bachelor degree level. The reason for this belief is because the term "biotechnology" describes a very broad and encompassing field. Dr. Roth indicated the field is so broad it is virtually impossible to have enough basic biology, chemistry, mathematics, and specialization courses in 4 years to be able to produce a bona fide biotechnician.

The best an Associate degree could do for a student, according to Dr. Roth, would be to provide enough basic biology, chemistry, and mathematics to allow a student to transfer to a four year program. Someone with an Associate's degree with introductions to microbiology and biochemistry could work as media or reagent preparers and sterilization technicians, but to call that person a biotechnician is stretching the truth. The term biotechnology is being used to describe so many things, it is beginning to lose its meaning.

Dr. Roth said he would be interested in talking with Triton College later this summer, if we are still interested in biotechnology.

Department of Biochemistry,
Molecular Biology, and Cell Biology
Northwestern University
2153 Sheridan Road
Evanston, Illinois 60201
Contact Person: Francio C. Neuhaus, Ph.D., Professor and Chairman

Dr. Neuhaus' department does not employ any technicians to serve the department as a whole. He indicated the Chicago campus did hire departmental technicians, specifically the Department of Microbiology.

Researchers within his department do hire technicians for research purposes and laboratory maintenance. These technicians hold Bachelor's and Master's degrees in the biological sciences or biochemistry or microbiology. Dr. Neuhaus said there is a demand in universities and industry for people with a two-year degree for the purpose of media preparation and sterilization. The two-year degree should include microbiology, chemistry and mathematics.

Department of Biochemistry
University of Illinois at Urbana Champaign
Urbana, Illinois 61081 (217)333-2013
Contact Person: Dr. Lowell P. Hager, Chairman

Dr. Hager's department employs technicians to run machines and equipment too costly for every researcher to purchase individually. These people are mostly Master degreed but have Bachelor degreed people working for them as assistants. Dr. Hager said it may be possible to train Associate degreed people to work as the assistants. Duties would include running equipment such as NMR (Nuclear Magnetic Resonnance), used to determine molecular structure and/or locations, and mass spectrometers, which can determine mass and molecular weights and molecular composition of compounds.

Nearly every faculty member hires research assistants to work on various projects within the laboratory. These people are mostly Bachelor and Master degreed people. In Urbana-Champaign there is a shortage of qualified laboratory technicians unlike Chicago, according to Dr. Hager. The pool of technicians is comprised mostly of spouses of students and faculty and staff. There are definitely more jobs than qualified people to fill them.

Dr. Hager would be very interested in seeing if Associate degreed people could help curb this technician shortage. He said the successful Associate degreed job candidate would need to have a very very strong background in biology, chemistry, and mathematics. It would also be nice if the candidate had had an introduction to microbiology and biochemistry.

Starting salaries for technicians would be in the $12,000 a year range. With experience and proficiency salaries could top $20,000 a year. Salaries are paid from research grants but Dr. Hager believes there will be a consistant demand for technicians. Most technicians are employed in laboratories for two to five years including an approximate six month in lab training period.

The University of Illinois at Urbana- Champaign seems to exhibit a special demand for technicians. In the Chicago area there are many universities graduating many people in the biological sciences, perhaps enough to satisfy the demand of the Chicago area for technicians. Also Dr. Hager indicated that those same people completing Bachelor degrees at the U of I leave the area for employment or graduate school, creating the shortage of technicians in the Urbana-Champaign area.

University of Illinois College of Medicine
Center for Genetics
808 South Wood Street
Chicago, Illinois 60612 (132)996-0162
Contact Person: Dr. Richard L. Davidson, Professor and Director

The Center for Genetics is conducting research in molecular biology, immunochemistry, virology, bacteriology, and cytology. There are two departmental technicians whose duties include media preparation, sterilization, and supply and laboratory maintenance. Their minimum level of education is high school graduate but it can be as high as a Master's degree. Every member of the Center's faculty has at least one full time research technician who carries out experiments. The fifteen research technicians in the Center have a Bachelor's or Master's degree in the biological sciences or related sciences such as biochemistry, microbiology, etc. Their salaries are paid from research grants and the salaries range from $14,500 to $20,000. with a provision for an 8%/year raise. Over the last five years 20-25 technicians have been hired indicating a turnover rate of 1-2 technicians per year.

Dr. Davidson said for someone to work in the Center's laboratories they should have knowledge of the following fields: classical, microbial, and molecular genetics; cell biology; biochemistry; microbiology; and a strong math background. Possibly not all of these fields need be included as actual courses - some may be incorporated as one course or some may be forgotten entirely. If each field (genetics, cell biology, biochemistry, microbiolgy, and math through calculus) were included, two years would not be enough time to finish the curriculum.

SUMMARY OF UNIVERSITY QUESTIONNAIRES DATA

EPARTMENT HEAD QUESTIONNAIRE[1]	I	II	III	IV	V	TOTAL
o you have any departmental technicians?	3/8[2]	6/8	1/3	1/3	0/2	11/24
ow many faculty have technicians?	30%	80%	85%	85%	90%	
o you have technicians for media making?	0/8	2/8	0/3	0/3	0/2	2/24
ESEARCH FACULTY QUESTIONNAIRE[3]						
ow many technicians currently employed?	25	50	30	30	25	160+
uties	research	research	research	research	research	research
ducation	B.S.,M.S.	B.S.,M.S.	B.S.,M.S.	B.S.,M.S.	B.S.,M.S.	B.S.,M.S.
alaries (starting)	-	-	$12,000	$12,000	$12,000	$12,000
raining	3-5 mo.	3-5 mo.	3-6 mo.	3-6 mo.	3-6 mo.	3-6 mo.
ow many have you hired over the last 5 years?	40	75	45	45	30	235+
inimum credentials	B.S.	B.S.	B.S.	B.S.*	B.S.	B.S.
hat would you include in AAS program?	biol.	micro.	micro. biochem.	biol. biochem.	micro. biochem.	micro. biochem.
ire AAS over B.S.?	no	no	no	no	no	no
emand in whole field?	maybe	maybe	maybe	maybe	maybe	maybe

Dr. Hager of University of Illinois at Urbana-Champaign said he would consider Associate degreed people.

(235 - 160) ÷ 5 = 15 technician openings per year.

See questionnaire sample on pages A23 and A24.

Example: three of the eight departments in this group answered yes.

See questionnaire sample on pages A25 and A26.

NUMBER OF POSSIBLE OPENINGS AVAILABLE TO TWO-YEAR GRADUATES IN THE REGION

	Now	3 years	5 years	10 years
Industry	25*	30+	15=	?
Universities	2	2	2	2
Total	27	32	17	?

* 24 of these openings are out-of-state

+ 17 in Illinois

= 12 in Illinois

The number of possible openings available for two year graduates was calculated from responses to the questionnaires. They are liberal estimates.

Cayuga County Community College
Franklin Street
Auburn, New York 13021 (315)255-1743
Contact Person: Susan M. Kuncio, Director of the Career Planning and Placement Office

The Cayuga County Community College catalog for 1982-84. lists a 2-year career oriented biological technology. Ms. Kuncio indicated they are thinking of phasing out the twenty year-old program. The reasons stem from a lack of job opportunities in the area for the graduates of the program. They are thinking of making the program more "chemical" in nature since there are jobs for this type of graduate.

Students enrolled in the program love it but there is no where to go once they graduate. Not only are there no job opportunities, but those students who wish to continue in biotechnology at a four-year school are better off taking a liberal arts curriculum at Cayuga to get their general requirements out of the way. Also, four-year institutions would prefer to teach the upper level biology courses themselves. Ms. Kuncio cautioned us to make sure there is a job market for biotechnicians in the Chicago or Illinois areas before initiating a similar program.

Pasadena City College
Pasadena, California (213)578-7123
Contact Person: Dr. Gunstream

Through correspondence with Dr. Raymond L. Teplitz of the City of Hope National Medical Center, it was ascertained that Dr. Gunstream was considering instituting a two-year program in cytotechnology, a subdiscipline of biotechnology. Dr. Gunstream said Pasadena City College decided against beginning the program for various reasons. First, the cost they would have incurred to start the program was prohibitive. Secondly, there were not enough positions for cytotechnologists on a constant basis in the area to warrant the program. Thirdly, California State University at Dominquez Hills already had a four-year program in cytotechnology that could adequately fill any positions in cytotechnolgoy when they occurred.

Dr. Gunstream mentioned that faculty and those organizations hiring cytotechnicians were very enthusiastic and encouraging towards the proposed program. Faculty members thought the program would appeal to many students, and organizations employing cytotechnicians saw an opportunity to develop future employees. Unfortunately, they could not guarantee a set number of openings for each graduating class. Dr. Gunstream also expressed his interest in reexamining the possibility of initiating the program in five years or so.

Washington University in St. Louis
Center for Biotechnology
Department of Chemical Engineering
Campus Box 1198
St. Louis, Missouri 63130 (314)889-6082
Contact Person: E.H. Dunlop, Ph.D., Professor

Dr. Dunlop was contacted by Vice President Magnesen in the Fall of 1983 in regards to a biotechnician curriculum for Triton College. Dr. Dunlop feels that the field of biotechnology is so broad it would be difficult for a community college to "provide for the needs of students and employers satisfactorily." He went on to say that "a good grounding in science is more important as each company has its own particular interest and method and a person with a round science base should have no problem adapting to the industrial interest." Dr. Dunlop also indicated that because of the fact that biotechnology is a relatively new field, a need for technician-level staff may surface in the future.

Rochester Institute of Technology
Department of Biology
P.O. Box 9887
One Lomb Memorial Drive
Rochester, New York 14623 (716)475-2496
Contact Person: Tom Frederick, Ph.D., Department Chairman

Dr. Frederick said that even though Rochester's biotechnology program is a four year program, it does not attempt to cover all of the disciplines of biotechnology. Also, Dr. Frederick indicated that the State University of New York (SUNY) system is trying to set up two year programs that specialize in only one area of biotechnology. He feels that specialization is the only thing a community college can hope to do in biotechnology. The specific area must be a "hot" or "trendy" field where there are many job opportunities. One such field is fermentation technology according to Dr. Frederick.

Another way a two year program could be successful would be if the community college were situated in close proximity to many research laboratories. One such program is being considered at the Technical College of Alamance in North Carolina. This school could feed its graduates right into the Research Triangle Park facility nearby. There is not a comparable situation in Illinois at the present time. The situation may exist if more biotechnology companies move into Chicago's High Tech Park.

Middlesex County College
Division of Engineering Technologies & Science
Edison, New Jersey 088018

Lois Pyle of Triton's Career Planning and Placement Center contacted Middlesex County College (MCC) and asked for information regarding their Biological Laboratory Technology program. The curriculum of MCC's program is very similar to the sample curriculum in the Biotechnology Company Questionnaire (see pages A2-A6) except MCC's program includes a course in biochemistry. Graduates of their program have been able to find jobs or they have continued their education. MCC's placement center has indicated employment opportunities for their graduates exist in scientific research firms, pharmaceutical firms, university laboratories, and federal and state laboratories.

Our research at Triton College has revealed that there is not sufficient demand in the Illinois area for technicians such as those produced by MCC. Furthermore, it would not be worthwhile for Triton to develop a biotechnician curriculum if the graduates then transfer to a four year program because four year schools would rather instruct their students in biotechnology courses themselves (see page A34).